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OBSERVATIONS ON THE OCCURRENCE AND BIOLOGY OF THE AEOLID NUDIBRANCH CUTHONA-NANA IN NEW-ENGLAND WATERS

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Observations on the Occurrence and Biology of the Aeolid Nudibranch *Cuthona nana* in New England Waters

BY

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(1 Plate; 3 Text figures)

INTRODUCTION

THE AEOLID NUDIBRANCH *Cuthona nana* (Alder & Hancock, 1842) has been found recently in substantial numbers in New England waters. The purpose of this report is to describe certain aspects of its ecology and biology. *Cuthona nana* has been reported to occur along the British coast (ALDER & HANCOCK, 1842; WRIGHT, 1856), in the Bering Sea (KRAUSE, 1885), in the North Sea (WALTON, 1908), and along the Norwegian coast (ODHNER, 1939). According to ODHNER (1929), KRAUSE's (1885) specimen from the Bering Sea was actually *Precuthona peachii* (Alder & Hancock, 1848). HARRIS (1973) listed *Cuthona nana* as occurring on *Hydractinia echinata* Fleming, 1828, in New England waters, but gave no further information.

In most cases reported, *Cuthona nana* was collected in association with the hydroid *Hydractinia echinata*. There is evidence that *C. nana* may on occasion eat other hydroids, for WRIGHT (1856) reported finding the nematocysts of *Campanularia* (= *Clytia*) *johnstonii* (Alder, 1856) as well as those of *Hydractinia* in the nudibranch's cnidosacs. This unusual occurrence of *Campanularia* nematocysts was used by Wright to argue for the non-molluscan origin of nudibranch nematocysts.

Cuthona nana is one of three species of aeolid nudibranchs reported in the literature as associated with *Hydractinia* species. *Precuthona peachii* has been found on *H. echinata* in European waters (SWENNEN, 1961), while on the west coast of the United States *P. divae* Marcus, 1961 has been reported in association with a *Hydractinia* species (MARCUS, 1961; MACFARLAND, 1966). ROBILLIARD (1971) reported finding *P. divae* on 3 other species of hydroids.

In the following sections, aspects of the ecology, behavior and reproductive biology of *Cuthona nana* will be described from field and laboratory observations.

TECHNIQUES AND PROCEDURES

Specimens of *Cuthona nana* were collected at two subtidal locations off the New Hampshire-southern Maine coast using SCUBA techniques. The field observations consisted primarily of collecting data, including habitat descriptions. The animals were maintained at 11 - 13° C in a closed, recirculating sea water system at the University of New Hampshire. Shells bearing *Hydractinia* colonies were included in the containers with the nudibranch. Observations were made particularly on the feeding behavior of the nudibranchs. Egg masses that were laid in the laboratory were removed to separate containers and their development was followed.

RESULTS AND OBSERVATIONS

Cuthona nana was first found in New England off Gerrish Island, Maine (Figure 1), in June, 1970. The nudibranch was later discovered in October of that year at the Isles of Shoals, 7 miles (*ca.* 10 km) off the New Hampshire coast (Figure 2). *Cuthona nana* has since been collected consistently at these 2 locations.

Off of Gerrish Island, Maine, is a small, shallow channel separated from the main channel of the Piscataqua River at the mouth of Portsmouth Harbor. There is a strong tidal flow of up to 8 knots over a rock, cobble, and sand bottom. The specific location for *Cuthona nana* and *Hydractinia echinata* is around a series of old wooden and rock cribs used to support submarine nets during World War II. *Hydractinia echinata* grows on rocks around the

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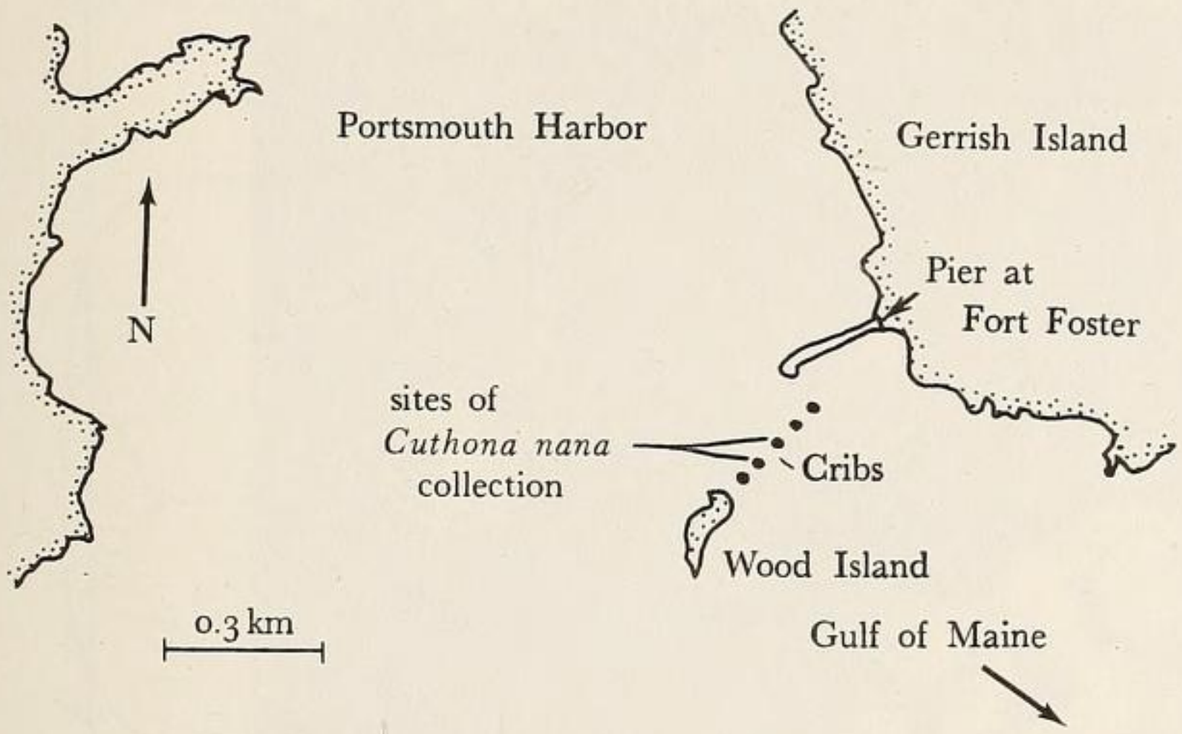

Figure 1

Shallow tidal channel at the mouth of Portsmouth Harbor (43°04′N; 70°42′W)

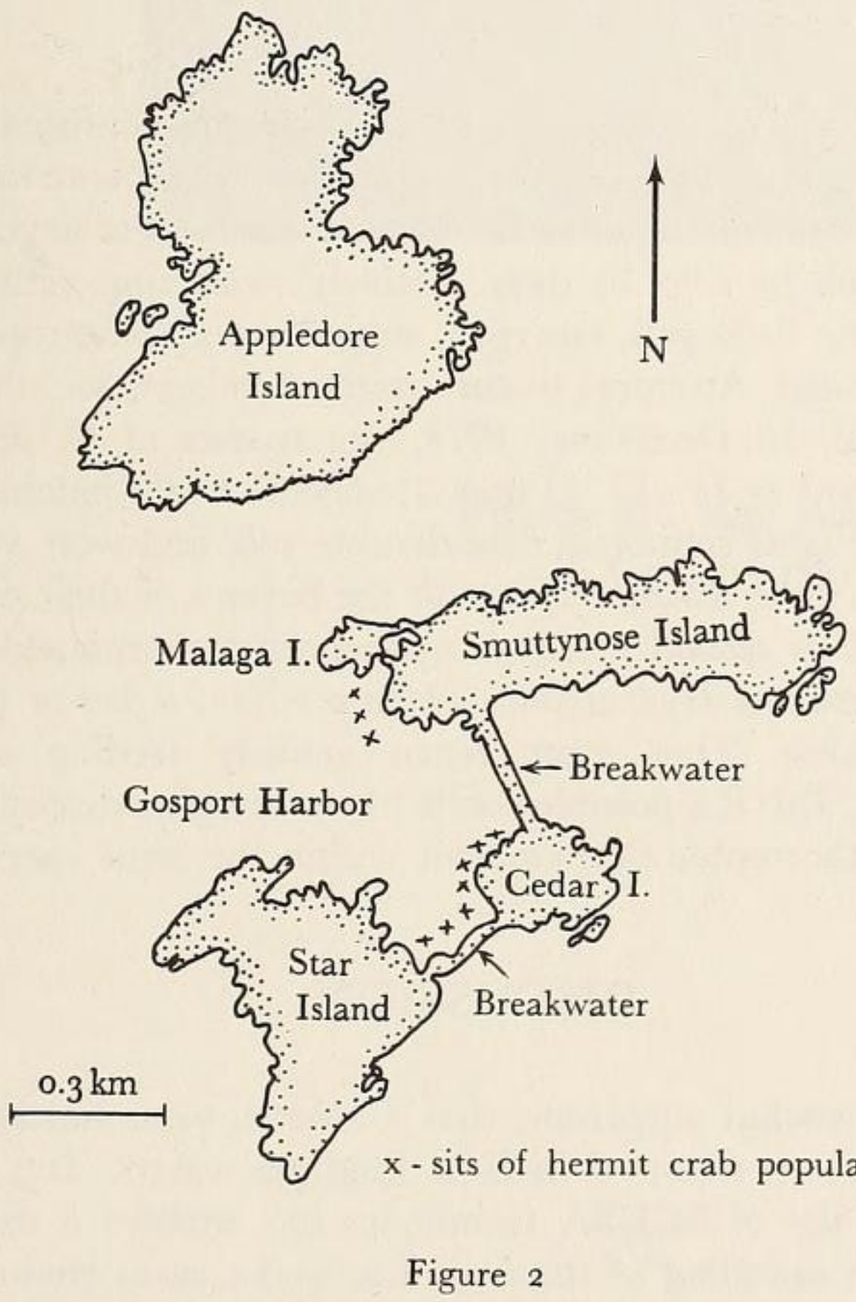

Figure 2

Diagram of Gosport Harbor, Isles of Shoals, off the Coast of New Hampshire (43°59′N; 70°37′W)

base of the cribs, on the wood of the cribs, and on holdfasts of large brown algae. The hydroid colonies may attain a diameter of 30 cm or more. This is one of the few locations where *H. echinata* has been observed growing on substrates other than hermit crab inhabited shells. Hermit crabs with shells bearing *Hydractinia*, however, have been observed in this area, although no *C. nana* have been observed on these shells.

The occurrence of *Cuthona nana* in this location is seasonal. The *Hydractinia* is most luxuriant between June and October and *C. nana* has been collected or observed during each of these months. At this time *C. nana* is often very numerous on *Hydractinia* colonies, with up to 20 individuals on a colony. *Cuthona nana* are found only on the underside of rocks on the colonies and have never been observed in a position such that they were visible from above. Egg masses may be found near the nudibranchs on dead parts of *Hydractinia* colonies.

A number of other organisms are also found associated with *Hydractinia echinata* at this location. The pycnogonid *Phoxichilidium femoratum* (Rathke, 1799) is often very numerous on the *Hydractinia*. The nudibranchs *Dendronotus frondosus* (Ascanius, 1774), *Coryphella verrucosa rufibranchialis* (Johnston, 1832), and *Doto coronata* (Gmelin, 1791), may be found around the edges of the colonies and definitely feed on *Hydractinia*. One of us (Harris) has observed as many as 10 to 15 *C. v. rufibranchialis* feeding around the periphery of a single *Hydractinia* colony. These nudibranchs, however, are not protected from the nematocysts of *Hydractinia*, and if one drops a nudibranch into the middle of a colony, the nudibranch is killed. This is in contrast to *C. nana* which is apparently immune to the nematocysts and is frequently found crawling throughout colonies of *Hydractinia*.

Cuthona nana is also found in Gosport Harbor at the Isles of Shoals. The harbor is formed by breakwaters between 4 of the islands. The harbor bottom drops off slowly from rock around the islands to gravel and then finally to sand. Within the harbor there is a large hermit crab population, particularly on gravel and sand at a depth of 5 to 15 m. The shell of the gastropod *Littorina littorea* (Linnaeus, 1758) is the dominant shell used by species of hermit crabs of which the 2 most common are *Pagurus acadianus* Benedict, 1901, and *P. arcuatus* Squires, 1964. Larger individuals, particularly of *P. acadianus*, also use shells of *Colus stimpsoni* (Mörch, 1867), *Buccinum undatum* Linnaeus, 1761, and *Lunatia heros* (Say, 1822). *Hydractinia echinata* is primarily found on shells occupied by *P. acadianus*. The *Hydractinia* colony begins developing on the lower lip or parietal wall of the shell and later grows around to cover the shell. The colony may grow out from the upper lip of the shell, increasing the living space for the hermit crab. The gastrozooids of *Hydractinia* are typically found expanded against the substrate as the

crab moves about, and close observations show that small amphipods, copepods, and annelids are captured by these expanded polyps.

Cuthona nana have been collected throughout the year on *Hydractinia*-bearing hermit crab shells. The infection rate in the spring and summer is as high as one for every 10 such shells, and in the fall and winter as low as 1 per 100. An individual shell may bear as many as 8 small *C. nana*. The nudibranchs attain a size of 25 mm on the hermit crab shells, in contrast to a maximum of about 15 mm at Gerrish Island. In the field, egg masses have not been found on hermit crab shells, but adult nudibranchs and egg masses have been observed on pieces of algae such as *Ulva* and on broken mussel shells, indicating that *C. nana* leave the *Hydractinia* colonies to lay egg masses. Since the nudibranchs do not die after laying egg masses, the adults must therefore be able to find new hermit crabs.

The crabs do not appear to bother the nudibranchs in the field even though the nudibranchs are often well within their reach underneath the shell near the aperture. In the laboratory, however, if they are left with the hermit crab, *Cuthona nana* may disappear within a day or two, particularly when more than one hermit crab is in the container. It may be that the nudibranchs are removed by crabs other than the one occupying the shell they are on.

FEEDING BEHAVIOR

The feeding behavior of *Cuthona nana* is very similar to that of the coral-eating nudibranch of the genus *Phestilla* Bergh, 1874 (Harris, 1970). The *C. nana* crawl with apparent immunity across colonies of *Hydractinia*, although they do tend to stay in one place while feeding, clearing patches in the *Hydractinia* colony. The oral surface of *C. nana* is flat, and nudibranchs have been observed placing this over individual polyps of *Hydractinia*. The buccal mass can then be observed moving up and down and tissue appears in the stomach with each upward movement.

EGG MASS AND VELIGER

The egg mass is a long and regularly coiled string with 2 to 4 capsules across the diameter (Figure *4*). The capsules, which contain a single egg averaging 160 μm in diameter, are irregularly distributed within the mass. The capsules are ovate in shape, with a length of 290 μm and a largest diameter of 220 μm. The veliger shells are like Thompson's (1960) type 2 (Figure 3).

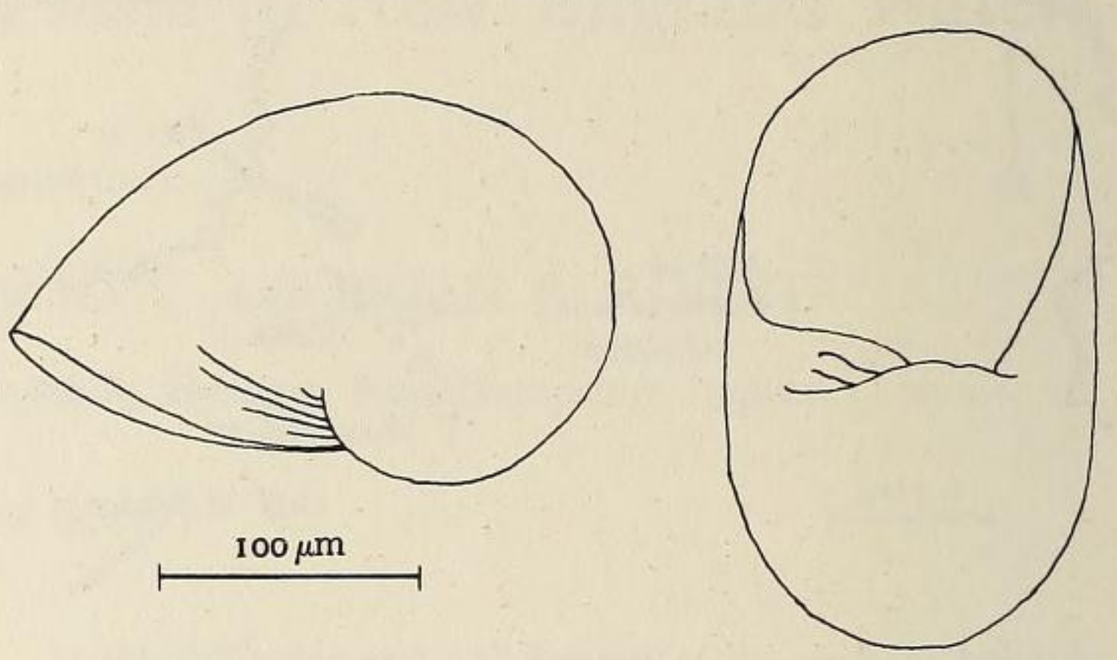

Figure 3

Camera lucida drawings of the veliger shell of *Cuthona nana*, lateral and ventral aspects

The development time and larval type are confused by conflicting observations. In February, 1971, *Cuthona nana* egg masses maintained at 13° C were observed to develop and hatch in 7 to 10 days. Actively swimming veligers containing little yolk emerged, suggesting planktotrophic development. Attempts to culture these veligers were unsuccessful. In December, 1973, egg masses of *C. nana* maintained at 11 - 12° C took 21 days to begin hatching. These veligers contained considerable yolk and were very inactive, never swimming up off the bottom of their container. This second group of veligers metamorphosed in the presence of *Hydractinia echinata* within a day or two of hatching. They soon began actively feeding and growing. This is a possible conflict between planktotrophic and lecithotrophic development within the same species.

DISCUSSION

It is somewhat surprising that *Cuthona nana* has only recently been reported in New England waters. The increasing use of SCUBA techniques has enabled a more thorough sampling of the New England coastal environment.

Collection data suggest that the population along this coast is quite stable, although seasonal fluctuations in numbers do occur. A population of a small aeolid similar to *Cuthona nana* was observed on *Hydractinia echinata* in North Carolina (R. Karlson, personal communication,

Figure 4: Egg mass of *Cuthona nana* laid on a mussel shell in Gosport Harbor. Egg mass dimensions: 9mm×6mm

1973), suggesting that the distribution of *C. nana* along the Eastern Coast is much more extensive than local populations observed in New Hampshire and southern Maine.

Three species of aeolid nudibranchs – *Cuthona nana, Precuthona peachii,* and *Precuthona divae* – have been reported to feed on *Hydractinia* species. All 3 are quite similar in morphology, coloration and biology. Their coloration is similar to that of the hydroids, which is to be expected since the coloration of these nudibranchs is primarily derived from the color of the digestive gland in the cerata and therefore from the pigments of the hydroids (Harris, 1973).

The differences in veliger behavior between those observed in 1971 and those currently being cultured suggest two possible reproductive strategies within the same species. If both active planktotrophic and inactive lecithotrophic veliger forms do occur, then one would expect some environmental stimulus to dictate the veliger type. Possible environmental stimuli might be temperature, light, water chemistry, presence or health of *Hydractinia* colonies and health of the nudibranch. Salinity is unlikely to be a factor in determining development type in *Cuthona nana,* for all the egg masses were kept under nearly identical conditions. Furthermore, the time of the year cannot be a factor since both sets of egg masses came from *C. nana* collected in Gosport Harbor in the late fall. Nutritional state of the adult nudibranchs or health of the hydroid colony are possibilities, since the nudibranchs maintained during the winter of 1971 were fed on unhealthy *Hydractinia* colonies.

It is possible that the *Cuthona nana* veligers of 1971 and those of 1973 were both lecithotrophic. There were obvious differences in yolk content and relative activity between these two sets of veligers. However, no attempt was made to induce metamorphosis in the 1971 veligers, and cultivation of what was assumed to be planktotrophic larvae failed. Answers to the question of development type as well as other aspects of the reproductive biology of *C. nana* are currently being studied by Rivest.

As Rees (1967) has suggested, the association involving *Cuthona nana* and *Hydractinia echinata* should be an excellent one for further study. Not only does it involve a possible species-specific hydroid-nudibranch association, but it also includes other relationships, such as those involving the hermit crab and the pycnogonid with *Hydractinia.* Studies of the association between *Precuthona divae* and *Hydractinia* sp. on the West Coast may also have potential, for both species are easily maintained in the laboratory.

SUMMARY

Populations of the aeolid nudibranch *Cuthona nana* in New England waters are reported. *Cuthona nana* may form a species-specific association with the hydroid *Hydractinia echinata.*

This association is found in two places in New Hampshire and southern Maine waters: a tidal channel at the mouth of Portsmouth Harbor, and in Gosport Harbor at the Isles of Shoals on sand and cobble bottoms. The hydroid is growing on rocks and other substrates in the tidal channel while it is only found on hermit crab shells at the Isles of Shoals. Some aspects of the ecology and the feeding behavior of *Cuthona nana* are described.

Preliminary studies on the developmental biology of *Cuthona nana* suggest the possibility of two reproductive strategies, although the differences may simply be variations within the category of lecithotrophic development. *Cuthona nana* veligers have recently been observed to successfully metamorphose in the presence of *Hydractinia echinata.*

ACKNOWLEDGMENTS

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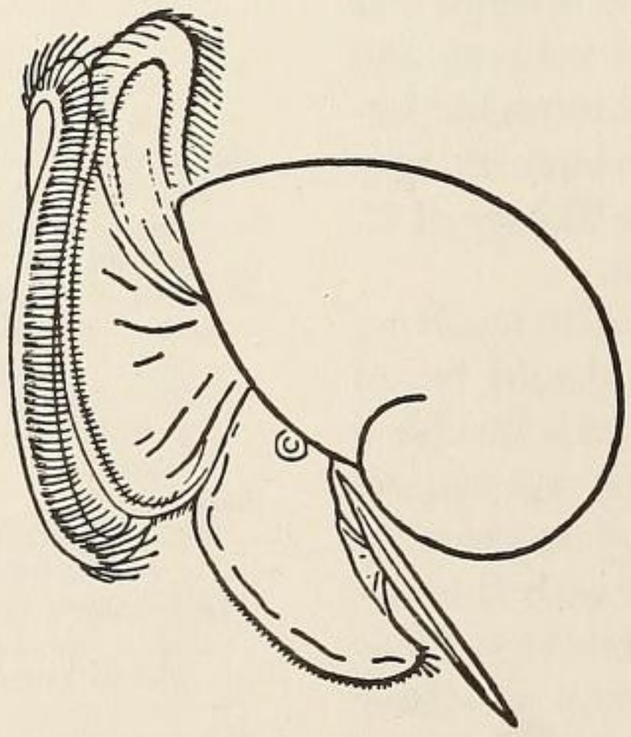

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Vol. 17; No. 3

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INTRODUCTION

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TECHNIQUES and PROCEDURES

Specimens of Cuthona nana were collected at two subtidal locations off the New Hampshire-southern Maine coast using SCUBA techniques. The field observations consisted primarily of collecting data, including habitat descriptions. The animals were maintained at 11-13°G in a closed, recirculating sea water system at the University of New Hampshire. Shells bearing Hydractinia colonies were included in the containers with the nudibranch. Observations were made particularly on the feeding behavior of the nudibranchs. Egg masses that were laid in the laboratory were removed to separate containers and their development was followed.

RESULTS AND OBSERVATIONS

Cuthona nana was first found in New England off Gerrish Island, Maine (Figure 1), in June, 1970. The nudibranch was later discovered in October of that year at the Isles of Shoals, 7 miles {ca. 10 km) off the New Hampshire coast (Figure 2). Cuthona nana has since been col-

lected consistently at these 2 locations.

Off of Gerrish Island, Maine, is a small, shallow channel separated from the main channel of the Piscataqua River at the mouth of Portsmouth Harbor. There is a strong tidal flow of up to 8 knots over a rock, cobble, and sand bottom. The specific location for Cuthona nana and Hydractinia echinata is around a series of old wooden and rock cribs used to support submarine nets during World War II. Hydractinia echinata grows on rocks around the

Portsmouth Harbor

Gerrish Island

sites of

Cuthona nana

collection

0.3 km

Wood Island

Gulf of Maine

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Figure i

Shallow tidal channel at the mouth of Portsmouth Harbor

(43°04'N; 7o°4q'W)

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^•: Smuttynose isiana

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Gosport Harbor

\V*- Breakwater

A^Cedar^I.

4^-.. Star •'^

<f^r^

(\-; Island

J Breakwater

0.3 km A -m

1 1 t: y^

X - sits of hermit crab populations

Figure 2

Diagram of Gosport Harbor, Isles of Shoals, off the Coast of New Hampshire (43°59'N; 7o°37'W)

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EGG MASS AND VELIGER

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100 /nm

Figure 3

Camera lucida drawings of the veliger shell of Cuthona nana, lateral and ventral aspects

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[Harris, Wright & Rivest] Figure 4

Figure 4: Egg mass of Cuthona nana laid on a mussel shell in Gosport Harbor. Egg mass dimensions: gmm^Gmm

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1973), suggesting that the distribution of C. nana along the Eastern Coast is much more extensive than local populations observed in New Hampshire and southern Maine.

Three species of aeolid nudibranchs - Cuthona nana, Precuthona peachii, and Precuthona divae - have been reported to feed on Hydractinia species. All 3 are quite similar in morphology, coloration and biology. Their coloration is similar to that of the hydroids, which is to be expected since the coloration of these nudibranchs is primarily derived from the color of the digestive gland in the cerata and therefore from the pigments of the hydroids (Harris, 1973).

The differences in veliger behavior between those observed in 1971 and those currently being cultured suggest two possible reproductive strategies within the same species. If both active planktotrophic and inactive lecithotrophic veliger forms do occur, then one would expect some environmental stimulus to dictate the veliger type. Possible environmental stimuli might be temperature, light, water chemistry, presence or health of Hydractinia colonies and health of the nudibranch. Salinity is unlikely to be a factor in determining dexelopment type in Cuthona nana, for all the egg masses were kept under

nearly identical conditions. Furthermore, the time of the year cannot be a factor since both sets of egg masses came from C. nana collected in Gosport Harbor in the late fall. Nutritional state of the adult nudibranchs or health of the hydroid colony are possibilities, since the nudibranchs maintained during the winter of 1971 were fed on unhealthy Hydractinia colonies.

It is possible that the Cuthona nana vehgers of 1971 and those of 1973 were both lecithotrophic. There were obvious differences in yolk content and relative activity between these two sets of veligers. However, no attempt %vas made to induce metamorphosis in the 1971 veligers, and cultivation of what was assumed to be planktotrophic larvae failed. Answers to the question of development type as well as other aspects of the reproductive biology of C. nana are currently being studied by Rivest.

As Rees (1967) has suggested, the association involving Cuthona nana and Hydractinia echinata should be an excellent one for further study. Not only does it involve a possible species-specific hydroid-nudibranch association, but it also includes other relationships, such as those involving the hermit crab and the pycnogonid with Hydractinia. Studies of the association between Precuthona divae and Hydractinia sp. on the West Coast may also have potential, for both species are easily maintained in the laboratory.

SUMMARY

Populations of the aeolid nudibranch Cuthona nana in New England waters are reported. Cuthona nana may form a species-specific association with the hydroid Hydractinia echinata.

This association is found in two places in New Hampshire and southern Maine waters: a tidal channel at the mouth of Portsmouth Harbor, and in Gosport Harbor at the Isles of Shoals on sand and cobble bottoms. The hydroid is growing on rocks and other substrates in the tidal channel while it is only found on hermit crab shells at the Isles of Shoals. Some aspects of the ecology and the feeding behavior of Cuthona nana are described.

Preliminary studies on the developmental biology of Cuthona nana suggest the possibility of two reproductive strategies, although the differences may simply be variations within the category of lecithotrophic development. Cuthona nana veligers have recently been observed to successfully metamorphose in the presence of Hydractinia echinata.

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